TITLE: Tactical Payloads for UAVs

Tactical Payloads for UAVs

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Introduction

The Tactical Systems Program Office of the Program Executive Officer, Cruise Missiles and Unmanned Aerial Vehicles PEO(CU) is developing and refining Payload Concepts of Operation (CONOPS) based on demonstrated capabilities, new technology, and emerging operator needs. The Tactical Systems Program Office continues to expand technical and operational capabilities for increased Unmanned Aerial Vehicle (UAV) applications. To support future military operations, the Tactical Systems Program Office foresees UAVs as a complement to manned and space based systems.

Traditionally, UAV Payload operations focused on the ElectroOptical/InfraRed (EO/IR) reconnaissance role. While still the highest priority requirement, new technologies have expanded potential payload applications. Aware of the importance of newly maturing technologies, the Tactical Systems Program Office continuously monitors technologies sponsored by the Government and industry to determine their direct application to UAV airborne platforms and ground stations.

The following discussion addresses the Tactical Unmanned Aerial Vehicle functional priorities.

Reconnaissance Surveillance & Target Acquisition (RSTA)

A method of direct support to the battlefield commander, RSTA utilizes tactical versus strategic methods of intelligence gathering IMINT and SIGINT. Information can be gathered months, days, hours or minutes prior to battle. RSTA technology employs the following methods/equipment to accomplish the objective.

Electro-Optical/Infrared (EO/IR)

Presently, the Pioneer UAV carries either an electro-optic daylight TV camera system or a day/night infrared imaging system. To lower costs while increasing capability, reliability, and maintainability, Naval Air Systems Command (NAVAIR) Pioneer Program Office has identified a requirement for a Pioneer payload to take advantage of off-the-shelf technologies and production capabilities. This payload, DS12, (Figure 1) maximizes the use of non-developmental components to provide a sensor payload, which combines Electro-optic and infrared imaging capabilities into a single low cost package. The Pioneer Program Office procured two prototypes and integrated them into the Pioneer UAV system. The Pioneer test team conducted six successful test flights at Webster Field, three day and three night flights. Since prototype testing proved successful, NAVAIR awarded a contract to deliver 40 units to the fleet by the end of this calendar year.

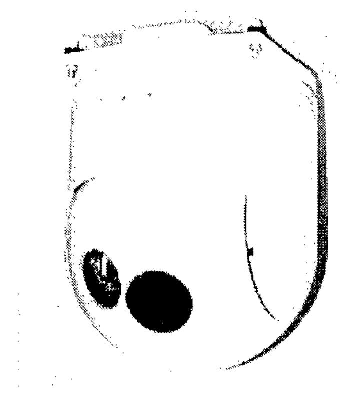

Figure 1

As the fleet transitions from Pioneer UAV to the Vertical Take-off and Landing Tactical UAV (VTUAV) program, the program office is considering the DS12 as the basic EO/IR payload.

Paper presented at the RTO AVT Course on "Development and Operation of UAVs for Military and Civil Applications", held in Rhode-Saint-Genèse, Belgium, 13-17 September 1999, and published in RTO EN-9.

MICRO-CAM

The small UAV community has never had the opportunity to provide mission operations in any scenario other than daylight conditions. The MicroCam, developed under a Small Business Innovative Research (SBIR) program, provides small UAVs no-light, and camouflage penetrating daytime images. The miniature, 20.3

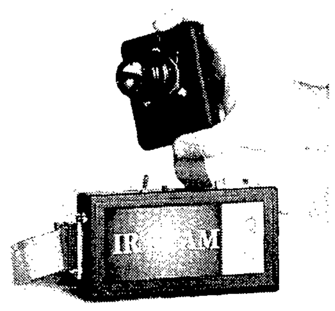

Figure 2

ounce, MicroCam infrared camera (Figure 2) produces high resolution thermal images in the spectral band of 7-14 μm. The microbolometer array eliminates cryogenic cooling and moving parts. It also reduces thermal stress, mechanical wear, and failures of the system. The MicroCam utilizes a unique infrared detector array to create the smallest and lightest camera possible. The MicroCam was integrated into the Pointer UAV for a night flight demonstration at China Lake in October 1998. The successful demonstration of the Pointer/MicroCam system in the Military Operations in Urban Terrain (MOUT) has resulted in continued support of the program in March 1999. Plans for gimbaling the system for installations into other Small UAVs are underway.

US Army Multimission Common Modular UAV Sensors

Communications and Electronics Command (CECOM) Night Vision Electronics Systems Division (NVESD) is conducting an Advanced Technology Demonstration (ATD) to identify potential designs to reduce cost and weight through commonality/modularity of hardware/software in the development of EO/IR and Synthetic Aperture Radar/Moving Target Indicator (SAR/MTI) sensors. This ATD will develop and demonstrate a common electronics package with a modular sensor to acquire either SAR or EO/IR imagery. During combat operations, users will remove and replace only front end sensors to support mission objectives.

SAR/MTI

In May 1998, CECOM awarded a contract to acquire two prototype airborne Synthetic Aperature Radar (SAR) systems (Figure 3), and two ground station elements. Delivery will occur early in calendar year 2000. An all weather imagery intelligence that also works in both day and night. It is a mature technology that is supporting Tactical platforms. The operational mode capabilities are side looking, spot and Moving Target Indication (MTI). Some disadvantages of the SAR are , it is relatively expensive, requires a large amount of processing capability and power and is more efficient when attached to fast moving vehicles. This development will leverage off previous development efforts for the Predator UAV.

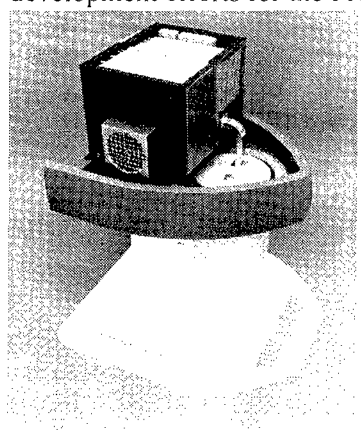

Figure 3

EO/IR

In February 1999, CECOM awarded a contract to acquire two prototype airborne units. Delivery will occur spring 2001. This development will leverage off sensor development efforts for the Predator and Pioneer UAVs.

Hyperspectral Imagery

The acquisition of images in hundreds of registered, contiguous spectral bands such that for each picture element of an image it is possible to derive a complete reflectance spectrum. This emerging technology combines spectrometry methods with remote sensing data acquisition. It can be used for military targeting, surface composition mapping, intelligence gathering and mine detection.

ORION Wide Intercept Relay

The ORION Wideband Intercept Relay (O-WIR) offers a light weight, low cost, small volume Electronic Surveillance (ES) system that provides real time location and identification of targets for battlefield information collection and control. The O-WIR payload effectively places surveillance antennas in deep forward rear battle area providing on the move ES.

From 20 to 30 January 1997, the O-WIR UAV payload prototype was evaluated on a Hunter UAV platform. This evaluation demonstrated the operational effectiveness of a wide bandwidth RF collector mounted inside the short-range UAV. The payload successfully retransmitted the target RF spectrum to any common EW sensor asset for processing, target location, and exploitation.

The O-WIR program conducted a phase two flight test effort in October 1998. To support the additional flights a second system was purchased. The Army deemed the demonstrations as a success however, they currently have no funding line for future O-WIR efforts. There is a Merit proposal for integration of the O-WIR into a Predator UAV.

Survivor Radio Repeater System (SRRS)

To improve the search and rescue (SAR) operations of downed aviators, a need exists to develop and integrate a Survivor Radio Repeater System (SRRS) into current and future UAV systems. The existing system is limited to Line of Sight (LOS) operation and transmits a low power signal to overhead manned aircraft. The short range of these signals creates an added risk to another manned asset in the early moments of the SAR mission. The development of a low cost, lightweight repeater system for UAVs would improve the operation of survival radio systems and increase operational range by eliminating the need for LOS operations. The SRRS solution must meet technical requirements; have minimum impact on UAV performance; work in existing SAR infrastructures; and adapt to a spectrum of UAVs.

A flight test program commenced on an EXDRONE UAV in September 1998. However, due to technical difficulties, the flight test program was temporarily suspended. The program restarted March 1999. The next procurement will modify these systems to add additional frequencies to support the personnel recovery operations.

Coastal Battlefield Reconnaissance and Analysis (COBRA)

The worldwide proliferation of traditional and nontraditional mines has generated an increasingly complex and sophisticated threat to amphibious operations. The detection of mines during operations from the very shallow water/surf zone to inland is critical to littoral warfare. To enable UAVs to remotely perform beach reconnaissance for mobility assessment, the USMC has embarked on COBRA

COBRA presents a near term battlefield reconnaissance, mine detection, and image analysis system. Using a multispectral EO sensor, it detects and identifies patterned, surface and/or buried mines during daytime and limited visibility conditions. To support automatic minefield and target recognition and manual detection of obstacles and fortifications, COBRA provides Near Real Time (NRT) image processing. Pioneer UAV System integration (Figure 4) and flight-testing were completed in November 1996. All submerged minefields were successfully detected. The program transitioned from ATD status to a full acquisition program in July 1998. Risk reduction studies are underway for Marine operations and potential insertion into VTUAV.

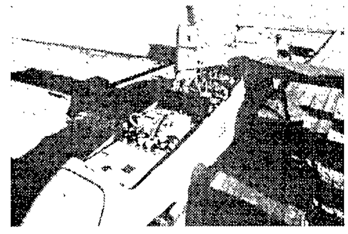

Figure 4

Tactical Dropsonde

The Naval Community is seeking improvements in the collection of meteorological data. To answer this requirement the Naval Space and Warfare Command has been developing the Tactical Environmental System (TES). TES includes the ALE family of countermeasures dispenser (CMD), minimal ALE electronics, and dropsonde canisters. The dropsonde canisters have internal sensors to collect air pressure, temperature, humidity and a GPS receiver to determine position and winds.

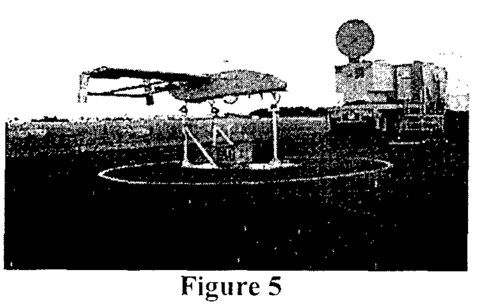

Figure 5

In the spring of 1997 this system was podded and installed on a Predator UAV. The successful dispensing and data collection resulted in the continuation of the program for a Pioneer installation (Figure 5). The Pioneer TES is a form/fit replacement for any standard Pioneer payload. The TES consists of a programmer/controller module; GPS receiver; sensor suite for measuring temperature, humidity, and barometric pressure and a 10-tube, modified ALE-47 dispenser assembly. For purposes of this demonstration, only 4 of the 10 dispenser tubes were electrically operable. Control of the TES from the ground station was accomplished via an independent 400 MHz UHF data link, which is controlled by a laptop computer. The computer also displays relevant GPS and meteorological data received serially from the TES. TES flight testing consisted of four separate flight events. The TES demonstrated the feasibility of a small, remotely controlled system to dispense a variety of expendables and link meteorological data to a UAV ground station. However, because of the failure of the T-Drop test assets, the tactical dropsonde data link portion of the TES could not be fully evaluated.

Presently the Government has awarded a contract to integrate the TES data from the pod into the Predator data stream. A follow on contract would marry the data into the Predator/Tactical Control System (TCS) interface. A production contract of T-Drops will be awarded spring 1999. To support fleet requirements, the Pioneer installation will address integration of tactical common data link (TCDL) and TCS.

Chemical Agent Detectors

Several years ago, the Defense Airborne Reconnaissance Office (DARO) hosted a series of workshops to further investigate the integration of advanced chemical sensors on UAVs. The objective was to merge practical chemical agent detection and warning systems with current MASINT technologies, advanced reporting networks, and unmanned platforms. The emphasis on UAVs is founded on the view that UAVs are unconventional platforms with lower acquisition, operational, and maintenance costs and no loss of life risk. UAVs are ideally suited to the unconventional mission of chemical detection. As a result of the contributions and inputs from all workshop participants a multiple area CONOPS was developed.

To validate aspects of this CONOPS, Central MASINT Organization (CMO) intends to execute the Chemical Agent Dual Detection Identification Experiment (CADDIE) demonstration. This demonstration will test the operational feasibility of many of the integration concepts. A CADDIE demonstration will be conducted in spring 1999 on an ALTUS UAV. The dual detection concept is supported by Chemical Dropsondes (chemsondes) and the Lightweight Standoff Chemical Agent Detector (LSCAD). The ALTUS UAV will carry both the LSCAD and the chemsonde dispenser internally. To support this flight demonstration, CMO will conduct a risk reduction flight program on a T-33.

Chemsondes are the same size as a standard MJU-10 chaff/flare canister and fit within pre-existing airborne or shipboard countermeasures equipment. The chemsondes are form-and-fit compatible with AN/ALE-47 countermeasures dispenser. This feature provides great flexibility with most combat operational aircraft.

There is a joint program to modify the LSCAD, called JS-LSCAD. The Army CBDCOM is lead on the program and has contracted for the development of a common detector that will be an early warning chemical system for land, sea, air, manned and unmanned vehicles. The JS-LSCAD is expected to be operational in 2003.

In addition to the CADDIE program, the chemical detectors have been integrated into a Pointer UAV system. This system was flown and evaluated at the Nevada test site March 1999.

CONCLUSION

The marriage of requirements and new technology represents a symbiotic relationship. The UAV JPO attempts to match new technology with emerging requirements. Once the UAV JPO has identified the potential application of new technology, it disseminates that potential to users in the field. The process includes the acquisition and production of prototypes which hopefully leads to a production contract for delivery to operational users.